LOOKING INTO THE BLACK BOX: THE CAUSAL IMPACT OF NPLS ON CREDIT SUPPLY

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We employ an extensive borrower-level dataset to study the influence of non-performing loans (NPLs) on the supply of bank credit to nonfinancial firms in Italy between 2009 and 2015. We use time-varying firm fixed effects to control for shifts in demand and changes in borrower characteristics, and exploit the supervisory interventions associated with the 2014 Asset Quality Review as a source of exogenous variations in the banks' NPL ratios. We find that, although bad credit quality shocks can temporarily reduce the supply of credit, the NPL ratios *per se* have no impact on the banks' lending behavior. The negative correlation between NPL ratios and credit growth in our data is generated instead by a simultaneous decline in firms' health and demand for credit. High NPLs affect the composition rather than the volume of credit, inducing banks to move away from low-risk firms.

Keywords: credit register, credit risk, credit supply, non-performing loans.

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1. Introduction

Does a build-up in non-performing exposures (NPLs) impair banks' capacity to finance the real economy? This question ranks high on the list of issues European policy makers have been grappling with over the past few years. The reasons are clear. Since the onset of the global financial crisis in 2008, the stocks of NPLs on the balance sheets of European banks have risen substantially; in Italy NPLs tripled, reaching 18 per cent of total loans in 2015. Besides raising concerns on the soundness of the banking sector, this phenomenon might trigger a vicious circle where the contraction in credit supply driven by the level of NPLs lead to lower growth, a slower recovery and hence a further deterioration in bank balance sheets.[1] Yet, as of today, formal evidence on the role and importance of bad legacy assets in shaping banks' lending policies is hard to come by. Two main issues need to be addressed in this discussion. First, the raw correlation between credit quality and credit growth observed in aggregated data can be misleading because rising NPLs are largely the endogenous product of a prolonged economic stagnation that weakens both the demand and the supply of credit. Second, deteriorating bank assets can trigger adjustment mechanisms that tend to affect lending in very different ways. Although an increase in NPLs is likely to temporarily reduce credit supply through its negative impact on bank profitability, it is unclear whether high NPLs can persistently alter the banks' lending policies, and if so in what direction. Like low capital buffers, large stocks of bad loans could create risk shifting and push banks to lend more, rather than less, or to tilt the composition of their loan books towards riskier borrowers[2].

Our first contribution to the literature is to attempt a tighter identification of the causal connection between NPLs and credit flows by exploiting a highly granular dataset, where the NPL ratios of all Italian banks are merged with information on banks' balance sheets and with data on borrower-level loans to Italian firms between 2008 and 2015. Since firms typically borrow from more than one bank at the same time, we can use time-varying firm fixed effects to capture unobserved changes in borrower characteristics, and test whether banks with different credit quality behaved in a different way towards the same firm at the same point in time (see Jiménez et al., 2014, and references therein). In this set up, changes in firms' profitability, creditworthiness, investment opportunities and demand for funds are separately accounted for, and the significance of NPLs can be more directly interpreted as evidence of supply-side effects. Our second contribution is to take advantage of the information coming from the Asset Quality Review (AQR), the in-depth supervisory credit book revision of 130 European banking groups carried out by the Eurosystem in

[1] See e.g. IMF (2015, 2017).
[2] Acharya and Steffen (2015), Altavilla et al. (2017), Fahri and Tirole (2017), Schivardi et al. (2017). See section 2 and 6.

2014, to study in detail a specific episode where NPLs rose for (nearly) exogenous reasons. If the balance sheet adjustments brought about by the AQR in December 2014 were (i) not correlated with changes in firms' conditions in 2015, and (ii) not entirely anticipated by the banks that took part in it, then they can be seen as exogenous "NPL shocks" and, as such, they can shed more light on whether unexpected fluctuations in NPLs affect bank lending in the short run. Our third and final contribution is to investigate the impact of high NPLs on the allocation of bank credit. By merging our borrower-level loan information with firms' characteristics, we can test how bank lending changed for borrowers with different profitability and risk profiles, thus looking for evidence of a more aggressive risk taking behavior associated to high NPLs.

We have three main results. The first and least surprising one is that exogenous increases in NPLs have a negative effect on bank lending, similarly to negative shocks to banks' capital buffers. The second result is that, on the contrary, the level of the NPL ratio *per se* does not influence a bank's credit volume. The negative correlation between NPL ratios and credit growth over the period we consider is almost entirely driven by firm-related factors: once these are properly accounted for (in our case, via time-varying firm fixed effects), a bank's lending behavior appears to be unrelated to its NPL ratio. The correlation between NPLs and credit observed at the aggregate level appears to be generated by a deterioration in economic conditions that acted simultaneously on banks (causing the increase in NPLs) and firms (leading to a drop in profitability and a decline in the demand for loans). This result is consistent with the diagnosis on the causes of the rise in NPLs in Italy presented by Angelini et al. (2017). The third result is that NPL ratios influence the composition of credit supply, discouraging banks from lending to low-return, low-risk borrowers.

The remainder of the paper is organized as follows. In Section 2 we discuss the economics of the relation between NPLs and credit supply and we summarize the existing literature on the topic. In Section 3 we describe our dataset. In Section 4 we present a set of stylized facts on the relation between NPLs, credit flows and bank funding costs. In Section 5 we move to a more formal econometric analysis of the economic significance of NPL ratios. In section 6 we study heterogeneity across firms. In section 7 we move to the causal study of how NPL shocks (in our case, through the AQR experiment) drive credit growth. Section 8 concludes.

2. The role of NPLs: transmission mechanisms and existing evidence.

From an accounting perspective, an unexpected rise in NPLs is likely to have a negative effect on bank's balance sheets via (i) the drop in profitability linked to higher provisions and (ii) an increase in risk weights and a consequent tightening of capital requirements. To keep an appropriate

coverage ratio – and hence protect itself against risk associated to mounting NPLs – a bank must indeed increase loan loss provisions so to reduce its exposure to the borrowers' defaults. Hence, under the combination of (i) and (ii) the adjustment on the asset side triggered by an increase in NPLs may have broadly the same implications as a decline in the bank's capital ratio, which is known to determine a contraction in credit supply.[3] To the extent that the deterioration in credit quality is publicly observable, these basic accounting mechanisms could be amplified by a rise in the bank's funding costs, which are another well-established driver of credit dynamics.[4]

These mechanisms clearly apply to changes in NPLs rather than to the NPL ratios per se. More specifically, they capture the banks' adjustments to a new, riskier equilibrium, but they are silent on whether and how the new equilibrium might differ from the initial one in terms of comparative statics. The impact of the shock can be more or less persistent, depending on the frictions the bank faces in adjusting its provisions, capital buffers and funding structure, but there is no obvious reason why a bank that has successfully absorbed an NPL shock should then keep lending less than its peers. This is an important difference, because the post-crisis policy debate has largely focused precisely on the stocks of bad assets as an obstacle to economic recovery.[5] If the cost of capital becomes permanently higher and earnings are persistently low, banks might of course adopt a permanently lower rate of expansion of their asset base.[6] Furthermore, high NPLs could be taken as a signal of lower managerial abilities; if this is deemed not to be fully offset by an adequate coverage ratio, then the bank's external funding costs could also turn out to be permanently higher. However, these possibilities are far from obvious. Testing them in a rigorous empirical setting is one of the key objectives of this paper.

More importantly, the accounting perspective provides only a partial view of how the banks' lending strategies might change in response to a deterioration in credit quality, and this picture changes radically once behavioral aspects are taken into account. Thinly capitalized banks might be prone to risk shifting and end up stretching their balance sheets and/or lending to bad firms (Krugman, 1998; Peek and Rosengren, 2005 ; Caballero et al., 2008). They may also become more sensitive to the "risk taking channel" of monetary policy, and hence more willing to extend credit to

[3] See e.g. Froot and Stein (1998), Van den Heuvel (2008), Aiyar et al. (2014). Capital buffers also matter for the transmission of monetary policy (Gambacorta and Mistrulli, 2004). For the role of capital during crises, see Beltratti and Stultz (2012), Berger and Bouwman (2013), Dagher et al. (2014).

[4] The literature on the bank lending channel of monetary policy (e.g. Kashyap and Stein, 2000) demonstrates the relevance of short-term interest rates. The role and transmission of funding shocks during the global financial crisis is examined e.g. in Cetorelli and Goldberg (2011).

[5] See e.g. IMF (2015, 2017).

[6] Under IRB (internal ratings-based approach), banks must calculate their risk weights on the basis of the losses their realize on non-performing exposures (among other factors); in this case, the managers' independent response to a rise in NPL might be reinforced by the regulatory pressure due to an increase in the capital absorption of the rest of the loan portfolio.

weak borrowers at times of low interest rates (Jiménez et al., 2014). These channels push in the opposite direction compared to those discussed above, suggesting that high-NPL banks may have an incentive to lend *more* than their competitors (and possibly more than they should), at overly lax conditions, or to the wrong borrowers.[7]

All in all, the lack of a well-defined theoretical framework makes it difficult to fully characterize the interactions between these mechanisms, or the conditions under which each of them is likely to be quantitatively relevant. This makes an empirical approach based on micro data particularly valuable in this context.

The empirical literature has thus far focused on the drivers rather than the implications of NPLs. These have been found to depend both on bank characteristics and on the macroeconomic performance of the economies where the banks operate.[8] The relevance of macroeconomic dynamics highlights the key endogeneity issue that undermines any attempt to identify a causal impact of NPLs on credit supply: NPLs rise in countries and periods where economic activity stagnates and, consequently, creditworthiness is deteriorated and the demand for credit also tends to be weak. Angelini et al. (2017) provide evidence on the key role of the macroeconomic conjuncture in driving up NPLs in Italy between 2008 and 2016, documenting that nearly 90% of the new NPL flows can be explained on the basis of macroeconomic factors, with a residual 4-8% accounted for by poor management choices. The role of bank-specific factors corroborates the idea that NPLs might act as a signal on the (idiosyncratic) weakness or misbehavior of the underlying banks. Increases in NPLs are indeed often anticipated by credit expansions and a loosening of lending standards.[9] They are also associated with prior reductions in banks' overall cost efficiency, suggesting that the two phenomena (high costs and high NPLs) might be symptoms of a common underlying problem, such as poor managerial practices.[10] As of today, however, little is known as to whether and how these factors exert any influence on banks' lending strategies. More importantly, the dominant role played by the macroeconomic environment in causing the rise in NPLs is a strong signal that a drop in the demand for credit might have played an important role in generating the negative correlation between NPLs and credit flows observed in the data. Our baseline regression set up is designed precisely to take this possibility into account.

Kaminsky and Reinhart (1999) note that high NPLs are often associated with the outbreak of banking crises, but both can be the result of macroeconomic forces that weaken simultaneously the banking sector and the real economy, such as strong exchange rate appreciations. Balgova et al.

[7] We discuss these possibilities in more detail in Section 6.
[8] Bofondi and Ropele (2011), Louzis et al., (2012), Klein (2013), Messai and Jouini (2013).
[9] Keeton (1999), Jiménez and Saurina (2006).
[10] Berger and De Young (1997).

(2016) study the relation between output growth and changes in NPL stocks using aggregate data on a panel of 100 countries between 1997 and 2014, finding that countries that actively reduced their NPLs typically experienced higher growth rates. Bending et al. (2014) estimate dynamics regressions using bank-level data for a sample of intermediaries from 16 European countries (excluding Italy) and document that both NPL ratios and changes in NPLs are negatively correlated with net growth in corporate and commercial loans in the following year. Cucinelli (2015) obtains a similar result for Italy, arguing that both NPLs and the loan-loss provision ratio (two similar proxies of the credit quality of the bank's portfolio) have a negative impact on the supply of bank loans. A common denominator on these works is the high level of aggregation of the data. The evidence points to a strong negative correlation between NPLs and credit; however, endogeneity problems are pervasive, and imply that moving from a statistical to a causal statement on the basis of country- or bank-level observations is fairly problematic. Against this backdrop, our main contributions to the debate are to (i) discriminate more explicitly between stocks and flows of NPLs, and (ii) exploit a loan-level dataset where identification is stronger and causality can be established with a higher degree of confidence.

3. Our dataset

Our analysis is based on an extensive dataset at the bank-firm level. For every firm we gather information on credit obtained by any bank operating in Italy.[11] For every bank, in turn, we recover a large set of balance sheet indicators, including the NPL ratios. We rely on two main sources.

For bank-firm credit relationships we use information on outstanding loan amounts from the Italian Credit Register (henceforth CR), over the period from 2009 to 2015. The CR records various end-of-year information on all loans exceeding 30,000 euros.[12] We focus on all non-financial firms, including very small firms, such as sole proprietorships. Data on credit quantity consists of both granted and drawn credit; as dependent variable we focus on granted credit, as this is more responsive to supply dynamics. Loans are made of three different categories of credit: revolving credit lines, term loans and loans backed by accounts receivable.

Our firm-level dataset includes overall 500 banks and more than 2 million borrowers, totaling more than 4 million bank-firm relationships. In order to control for unobservable heterogeneity through firm-time fixed effects, in our regressions we only include firms borrowing from at least

[11] We consider banking groups and individual banks for those not belonging to a group.
[12] The threshold was reduced from 75,000 to 30,000 euros in 2009. In the analysis in which we include 2008 we restrict our sample to include only loans above the initial threshold of 75,000. For analysis restricted to post-2009 periods, we keep the threshold at 30,000.

two banks. This still leaves more than 2 million bank-firm relationships, given that multiple lending is particularly common in Italy across a large set of firms (Detragiache et al. 2000, Gobbi and Sette 2014), and therefore is not too restrictive of a condition.

Table 1 displays some basic statistics on our data. The first panel shows the average changes in log credit granted over time, corresponding to the left-hand side variable that will be used in our regressions. Credit granted to all firms decreased on average in all the years under analysis. The statistics are reported for the whole of the banking sector and for some categories of intermediaries. In particular we look at banks that underwent the Comprehensive Assessment of 2014 (AQR banks) versus the remaining ones, and we also isolate mutual banks.[13] This first distinction, as we will see later, is particularly useful to try to assess the impact of exogenous variations of NPLs on credit supply.[14]

We use bank-level information on a consolidated basis from the Supervisory and Statistical Reports submitted by the intermediaries to the Bank of Italy. We gather information from both balance sheet and profit and loss accounts to build some sensible indicators of banks' structure and health. The main variables that we consider are total assets, as a proxy of size, Tier 1 Ratio to capture capitalization, Return on Equity for profitability, provisions over operating profit to assess the relevance of the yearly flows of provisions on operating margins and finally the cost to income ratio as a measure of efficiency.

Table 2 shows how these variables changed over the period 2008-2015, for the aggregate of the banking sector as well as across the sample split we already used for Table 1. Clearly, average NPL ratios went up dramatically and the phenomenon was widespread across bank types. In particular, the NPL ratio almost tripled since the beginning of 2008 for AQR banks and more than tripled for other banks, including mutual banks. As a consequence, the impact of provisions over operating profit grew largely between 2008 and 2014. In particular, there was a spike in 2013 and 2014, associated with the aforementioned Asset Quality Review. The flip side of the coin was that profitability, which had declined since the beginning of the period analysed, turned negative in 2011, and again in 2013 driven by AQR banks that had been already recording losses since 2013; at the same time, coverage ratios increased, reaching an average of 45 per cent. This was not associated with a significant deleveraging process, given the continuous increase in capital.

[13] Mutual banks are characterized by a different business model with respect to other banks; they are local and not-for-profit cooperatives. Even if the recent legislative reform had the aim to stimulate these banks to be more integrated through the institution of a cooperative banking group, in the period under analysis these banks acted as a very different player.

[14] In the appendix other data are reported as derived from the CR, which show the patterns of three very relevant features of bank-firm relationships. They will be used in our causal analysis to take into account the specific characteristics of the matching between borrowers and lenders.

Capitalization indeed grew throughout the 8-year period. For smaller banks, it almost reached 17 per cent; for larger banks (such as the AQR ones), after a steady increase, tier 1 ratio stood at over 12 per cent by the end of 2015.

4. NPL ratios across banks and over time

The motivating evidence behind our work is summarized in Figure 1, which shows two contemporaneous aggregates facts. The aggregate ratio of NPLs over total credit was just around 6 per cent at the outbreak of the Lehman crisis and it grew constantly reaching almost 20 per cent over the following seven years. Meanwhile, for more than half of the period under examination credit growth to the Italian economy was negative (Panel A). Panel B confirms that the phenomenon is particularly pronounced for loans to firms.

To shed more light on this correlation, we move from aggregate to bank-level data and check the relation between the individual banks' NPL ratios measured at three specific, significant dates and the banks' subsequent performance in terms of lending and profitability. The first date we pick is the end of 2008: this provides a picture of the system in the immediate aftermath of the Lehman default, at a time when Italian banks had not yet been affected by the global financial crisis. The second snapshot is taken at the end of 2010, before Italy was hit by sovereign shocks that caused further financial market distress (Bofondi et al. 2017) and the second prolonged recession within less than ten years. The third date is December 2015: by that time the impact of the global and sovereign shocks had fully materialized. In the scatterplot of **Figure 2** banks' credit growth rates between 2008 and 2015 (vertical axis) are plotted against their initial NPL ratios (horizontal axis). The correlation is very low. The negative correlation shows up both in the 2008-2010 period and in the 2010-2015 period (Figure 3). All in all, the link between credit and NPL therefore seems to be confirmed by the bank-level data.

Another interesting issue is how strongly correlated the NPLs ratios are over time. Our data suggests that the correlation is fairly low. In Figure 4, the banks are sorted on the horizontal axis based on their pre-Lehman NPL ratios and the scatterplots show how these changed between 2008 and 2015. The initial ratios, displayed in red, range from zero to just below 35 per cent. The distribution is roughly unchanged at the end of 2010 (green dots). By the end of 2015 (blue dots), however, the increase in NPLs is more pronounced and, more importantly, the initial ranking across banks is entirely lost: many of the banks whose initial NPLs were below 10 per cent, for instance, end up in the same situation as those that started with NPLs of 20 per cent or higher. This confirms

that the cyclical conditions of the Italian economy – a systemic risk factor common to all banks – were an important driver of the NPLs.

To check whether banks with high NPL ratios share other common balance sheet characteristics we examine next the relation between NPL ratios and some basic balance-sheet indicators. In **Figures 5-7** we plot the correlation between NPL ratios and, respectively, the log of total assets, capital ratios and the cost to income ratio, focusing again on the three pivotal dates of end-2008, end-2010 and end-2015. Figure 5 shows that up to 2010 higher NPLs were concentrated among small banks, while by 2015 they had largely increased for all banks regardless of their size. This widespread growth is consistent with figure 4 and is another sign of the emergence of aggregate drivers of the NPLs linked to weak macroeconomic conditions. Figure 6 shows that the correlation between NPLs and capital is fairly weak and changed sign over time, with a higher concentration of NPLs in less capitalized banks at the end of our sample. Interestingly operating costs seemed to be positively correlated with credit quality at times of low NPLs, as shown in Figure 7. Although this correlation might be caused by a number of factors, one possibility is that a higher presence of bank personnel and/or higher investments in IT might make intermediaries more capable of screening and monitoring their clientele. In 2015 cost to income ratios had become much less heterogeneous across banks with different credit quality, perhaps because the deep recession had again largely wiped off longitudinal differences in the relationship between banks' characteristics and NPL ratios.

The descriptive evidence suggests three broad conclusions. First, balance sheet conditions deteriorated rapidly for most banks, with soaring NPL ratios that might have also affected profitability. Second, banks presumably activated (either spontaneously or under regulatory pressure) various precautionary mechanisms, raising their coverage ratios and strengthening the capital base, with the aim of increasing resilience even at the cost of weakening current profits. Third, banks with high NPL ratios do not have obvious balance sheet characteristics in common. This result is in consistent with the conclusion by Angelini et al. (2017) that the accumulation of bad loans was largely driven by aggregate macroeconomic conditions. Since these also act on the demand side of the credit market, this conclusion is also a reminder of the difficulty one faces in identifying the supply-side effects of rising NPLs.

5. A panel analysis with unobserved firm heterogeneity

To investigate the causal relation between NPLs and credit dynamics we estimate a range of credit supply equations where the banks' NPL ratios feature as a potential driver of their lending strategies. The general form of the regression model is the following:

$$\Delta Loans_{ijt} = \alpha_{jt} + \alpha_{ij} + \gamma NPL_{i\,t-1} + \sum_f \delta_f Z_{fij\,t-1} \quad + \varepsilon_{ijt}, \qquad (1')$$

where the dependent variable ($\Delta Loans_{ijt}$) is the yearly (log) growth in credit granted by bank *i* to firm *j* at time *t*. The key regressor is of course the bank-specific NPL ratio (NPL_{it-1}), which is measured net of the stock of provisions.[15] The null hypothesis of interest is that banks with high NPLs lent less to firm *j* (controlling for its characteristics), leading to $\gamma<0$. The regression includes bank (or bank-firm) fixed effects α_i (α_{ij}) and various firm-bank relationship controls $Z_{fij\,t-1}$. The advantage of using a borrower-level dataset that includes multiple lending relations is that a time-varying borrower-specific effect α_{jt} can be included among the regressors to control for shifts in borrowers' characteristics, including demand. Intuitively, as long as the demand-side shocks that affect firm *j* (including for instance a drop in sales, or lack of investment opportunities) influence all of its lending relations in the same way, the fixed effect α_{jt} guarantees that their influence is removed from the data and that the remaining regressors in equation (1) capture exclusively supply-side factors. The presence of α_{jt} is thus essentially what allows us to interpret the rest of the equation as a model of the *supply* of credit (Khwaja and Mian, 2008).

Table 3 contains the results of the estimation of the subsequent specifications. We build up the regression model gradually. Column 1 shows the results of a naïve version of equation (1) that does not include bank and firm controls. The coefficient obtained from the simple, univariate OLS regression in column 1 is positive but not significant. By introducing firm fixed effects (column 2) we move to a 'within firm' type of analysis. This delivers a negative and significant coefficient which is in line with what one might expect looking at patterns in the data: for a given firm, high NPLs in the balance sheet of the lender are associated to a decline in credit which is at least consistent with NPLs discouraging bank lending. The negative coefficient in column 2 implies that the correlation between NPL ratios and credit is not entirely explained by fixed firm characteristics: in other words, it rules out the possibility that firms that are altogether "bad" (on account for instance of low productivity or poor management) are entirely responsible for the link between high NPLs and declining credit flows in the data. A number of possible interpretations remain open though. In particular, this specification cannot discriminate between (i) a genuine supply-side effect

[15] We could alternatively include both gross NPL ratio and coverage ratio as distinct regressors, accounting separately for the impact of each, but the results are similar to those obtained with this more parsimonious specification of the model.

of the NPL ratios and (ii) a plain correlation between NPLs and credit caused by shocks that affect both banks and firms – such as those linked to the macroeconomic cycle.

We introduce firm-time fixed effects in column 3, and keep them in all subsequent specifications. Even without any additional control variable, the presence of these dummies renders the NPL ratio statistically insignificant. This means that the behavior of two hypothetical banks in our sample towards a common borrower *j at any time t* was not influenced by their NPL ratios. We emphasize again that it is the presence of firm-level time-varying fixed effects (and hence of a bank-borrower level dataset) that makes it possible to draw this conclusion. This result is crucial in answering our first question. The lack of significance of the regressor in column 3 implies that the correlation between NPL ratios and credit growth in the data is driven by variations in borrower characteristics. These are likely to include changes in firms' riskiness, profitability and investment opportunities, all of which largely deteriorated over our estimation sample. Changes in demand could play an important role too. The demand for credit generally weakens in recessions, when firms have fewer investment opportunities and are more uncertain about their future. Furthermore, Alfaro et al. (2016) show that opaque and financially-constrained firms have a precautionary reason to reduce their debt in 'bad times' (i.e. when volatility is high). This means that credit demand does not change in the same way for all firms over the cycle. The number of financially-constrained firms increases in bad times. If these firms demand less credit for precautionary reasons, then the correlation between rising NPL and falling credit in column 2 might also be driven by demand factors, which are instead removed by the firm-time fixed effects included in column 3. Column 4 also add observable time-varying characteristics of the bank-firm relationships, and results still hold.

The remainder of Table 3 shows the results of the regressions that include bank fixed effects (and bank firm fixed effects) offers some less intuitive results, that must be carefully interpreted based on the source of variation at the bank level that is implied by the de-meaning process of the different bank fixed effects.

When taking into consideration bank-level time invariant heterogeneity, that is, when we plug also bank fixed effects, as in Column 5, we are accounting for the different structural features of banks, such as business models, that might have played a role in structurally affecting bank credit supply. Even when controlling for observed and unobserved heterogeneity at the bank level, banks whose NPLs are comparatively higher (and that have increased over time more markedly) do not seem to be lending less to the same firm relative to other banks.

Our descriptive statistics show that 2008-2015 was a period of rapidly changing (and mostly deteriorating) balance sheets, so it is also important to examine the relevance of other balance sheet indicators whose concurrent evolution accompanied the rise in NPL ratios. Thus in **Table 4** we expand the specification of Table 3 to introduce observable bank characteristics such as size, capital ratio and ROE, which are represented by $X_{ki\,t-1}$ in the following equation

$$\Delta Loans_{ijt} = \alpha_{jt} + \alpha_i + \gamma NPL_{i\,t-1} + \sum_k \beta_k X_{ki\,t-1} + \sum_f \delta_f Z_{fij\,t-1} + \varepsilon_{ijt}$$

We adopt the same gradual strategy used for Table 3 and progressively saturate our specification. The results show that also when including other time-varying bank features, the NPL ratio remains insignificant. Unlike the NPL ratio, bank capital is positive and significant in all specifications. Notably, regressions without the bank fixed effects show how mutual banks' credit growth was consistently higher relative to other banks.

Before moving to the AQR analysis we briefly discuss an alternative version of table 3 where the NPL ratio is replaced by the flow of new bad loans over outstanding loans (*New Bad Loan Rate*), again lagged relative to the dependent variable. This flow variable measures the variation in the lowest-quality segment of the banks' NPLs and, as such, should capture some of the exogenous shocks that hit banks' balance sheets in our sample period. The results are reported in **Table 5**. The coefficients are qualitatively similar to those obtained in the specifications based on the NPL ratios, but the bad loan rate achieves statistical significance, albeit weak, even in some of the regressions that include firm-time effects (see column 4). This is a first indication that NPL shocks might matter even if the NPL ratio *per se* does not. However, this regressor may still be affected by an endogeneity problem. In the next section we try to exploit the Asset Quality Review to get around this problem.

6. A tale of risk shifting

Bank fragility might distort the allocation of credit rather than its aggregate level. During the 1990s, Japanese banks notoriously kept lending to insolvent borrowers ('zombie' firms), reducing the profits and investments of the healthier firms in the economy (Peek and Rosengren, 2005, Caballero et al., 2008). A similar phenomenon occurred after 2008 in the Eurozone. Schivardi et al.

(2017) find that under-capitalized banks in Italy allocated credit inefficiently, supporting non-viable firms at the expense of healthy firms, although the implications for growth were in this case negligible. A second distortion might emerge if fragile balance sheets enhance the banks' incentives to 'gamble for resurrection', for instance by investing in risky government bonds that are highly correlated to their own returns (Acharya and Steffen, 2015, Altavilla et al., 2017, Fahri and Tirole, forthcoming). Banks could in principle pursue the same objective by changing the composition of their loan portfolio and by allocating credit to riskier, more cyclical or more correlated firms, thus increasing the level of aggregate risk on their balance sheet. These mechanisms are usually triggered by low capital levels, but high NPL ratios could in principle play a similar and equally distortionary role: that would be the case, for instance, if banks had private information on the (low) recovery value of their exposures. Importantly, this risk shifting mechanisms are linked precisely to the level of NPLs – a proxy of the bank's overall solidity – and not to its temporary fluctuations.

To investigate whether and how rising NPLs affected the composition of credit supply we run an additional set of regressions that discriminate among different types of borrowers. In particular, we replicate the baseline regression of Column 4 of Table 4 for sub-samples of borrowers that differ in terms of four characteristics[16]: size, ROA, leverage and the Altman et al. (1994) Z-Score, a common proxy of overall riskiness.

The results are reported in **table 6**. The first two columns compare the behavior of banks towards firms located above and below the median of the firm size distribution (columns 1 and 2). The comparison is then replicated using ROA (cols. 3-4), leverage (cols. 5-6) and the z-score (cols. 7-8). In all cases, the regression includes firm-time fixed effects and the usual set of bank-specific and relation-specific controls. Splitting the firms according to their size or leverage makes little difference: in these cases the NPL coefficient is not significant, and all remaining regression coefficients are broadly similar across subsamples.

A first interesting difference appears in the ROA regressions: profitable firms are negatively affected by high NPLs, whereas the other ones are not. The statistical significance of the difference, however, is pretty low. The Z-scores regressions uncover a similar pattern: high NPLs caused a credit contraction only for highly rated firms (col. 7 vs col. 8). In this case the size of the NPL coefficients is very different across the two subsamples and the impact of NPLs on 'safe' firms is significant at the 5% level. Taken together, these results suggest that higher NPLs did push banks to reallocate credit to weaker and/or riskier borrowers. Furthermore, the regressions based on size and leverage can be read as a *placebo* test that confirm the emergence of a genuine risk-driven credit

[16] The results are confirmed if we run the regressions on the entire sample of firms, interacting the banks' NPL ratios with the relevant firm characteristic. The results are available upon request.

reallocation. Although our results are broadly consistent with Schivardi et al. (2017), they also point to a potential difference between "weak" and "risky" borrowers that might be important from a policy perspective: unlike zombie lending, the issuance of riskier loans is not necessarily detrimental in terms of welfare (the projects funded by the bank might be at the same time risky and valuable in expected terms), and it might be to some extent physiological in a recessionary environment. We leave this issue to future research.

7. The AQR as an exogenous NPL shock

Even if 'in equilibrium' high NPL ratios do not discourage banks from lending, a sudden exogenous increase in bad loans (an 'NPL shock') may push them to temporarily change their lending policies (see Section 2). To examine this possibility we adopt an event study approach and study lending dynamics around the 2014 Asset Quality Review (AQR) carried out by the European Central Bank.

The AQR was part of the Comprehensive Assessment, a year-long examination of the resilience and positions of the 130 largest banks the euro area that the ECB undertook, together with national supervisors, in preparation of the launch of the Single Supervisory Mechanism (SSM). The AQR consisted in a check of the quality of the assets held at the end of 2013, based on a set of common definitions. Much of its focus laid in the analysis of the loan book, and it basically verified two aspects on a sample of loans selected from the riskiest portfolios: (i) the accuracy of loans' classification in the performing and non-performing categories; (ii) the adequacy of the related provisions, taking account of the valuations of the collateral covering the exposures. The second step of the Comprehensive Assessment was to quantify the capital strengthening measures to be taken, based on a stress test conducted with reference to a baseline and an adverse macroeconomic scenario. Fifteen Italian banks took part in the comprehensive assessment; of these, 13 now fall directly within the perimeter of the SSM.

If the balance sheet revisions associated to the AQR were at least in part (i) independent of the business cycle conditions faced by the bank borrowers in the subsequent year and (ii) unanticipated by the banks, then they can be interpreted as exogenous variations in the quality of the balance sheets and exploited to understand how (if at all) banks adjusted their lending in response to them.[17] We exploit this idea in two ways.

[17] Both assumptions are rather demanding. Supervisors might have taken into account the characteristics of loan portfolios following 2013, and the nature, scope and broad objective of the AQR were obviously not a surprise for the banks in any way. However, while banks used a variety of internal models, the AQR was conducted based on a shared and unique framework. This implied that supervisors had limited margins for adopting different approaches towards different banks and based most of their assessments on end 2013 balance-sheets. Furthermore, the complexity of the

7.1 A difference-in-difference approach

First, we consider the whole set of Italian banks and compare the lending behavior of AQR banks to that of non-AQR banks before and after the exercise, within a *difference-in-difference* type specification.[18] As mentioned, the AQR led to an increase in provisions and requirements across the participating banks. Furthermore, the fact of being included in the review meant that these banks faced at least a non-negligible risk of having to deal with a (supervisor-driven) downward revision in the quality of their portfolios. This might have been a good enough reason to lend more conservatively. Hence, the AQR might have induced a *systematic* downward shift in credit supply for banks that were subjected to the review relative to those that were not.[19] We examine this possibility by testing whether the banks that received the "AQR treatment" displayed a different lending behavior in the aftermath of the review compared to those that did not. Defining adequate pre- and post-treatment time windows in this setup is far from trivial. We consider 2012-2013 as the pre-treatment period and 2014-2015 as the post-treatment period. The AQR was announced on October 23rd 2013, and conducted throughout 2014 based on bank-balance sheet results of end-2013. Nevertheless, since (i) the review appeared in the media well before being its official announcement, and (ii) banks tend to smooth out their balance sheet adjustments if possible, focusing on too narrow a window of a few months around the end of 2014 would be misleading.

The results are reported in **Table 7**. Our dependent variable is the log change in credit growth. Columns 1 and 2 show the simplest diff-in-diff specification, comparing the difference in growth over the two periods between the two subsamples of banks via a bank dummy (AQR bank) and a time dummy (post AQR). The positive coefficient in column 1 reveals that lending was on average higher for AQR banks and this differential pattern continued after the supervisory exercise, even when we take into account systematic bank differences by including bank fixed effects (column 2). Column 3 and 4 allow to gauge whether heterogeneity in NPL ratios induced banks to adjust their credit supply differently after the review took place. Interestingly, AQR banks still appear to have lent at higher rates on average (column 3), but not more intensely in the AQR period, as the interaction between the time and the bank dummy shows (columns 3 and 4). NPLs *per se* do not weaken lending growth; in fact, NPL ratios have a puzzling positive coefficient. Nevertheless,

process and the discrepancies among models were such that banks were unlikely to be able to accurately predict the outcome of the review. The identification strategy we discuss below hinges on the presumption that there were non-negligible differences between what the banks expected and what they observed when the process ended in December 2014.

[18] The analysis is again conducted using matched bank-firm relations and firm fixed effects on the same dataset that was employed for the analysis of Tables 3-5.

[19] Moral suasion and competitive pressures might have blunted the actual difference between being inside and outside the AQR list to some extent, but it is unlikely that they made it entirely irrelevant.

the negative interaction between NPL ratios and AQR dummy shows that AQR banks that had a higher share of non-performing exposures lent on average relatively less, supporting the case of a differentiated behavior across AQR banks based on their initial credit quality. As shown by the triple interaction in column 4, after the revisions induced by the AQR, though, the impact of NPL ratios *within AQR banks* seems mitigated. A possible interpretation for this is the improvement in transparency and confidence yielded by the review; however many other factors, including a relative improvement in macroeconomic conditions, could have played a role too.

The diff-in-diff specification suggests that the relation between NPL ratios and credit is not clear-cut; in most cases the share of non-performing loans becomes insignificant once demand and bank-level characteristics are properly accounted for, in line with the results in Section 5. At the same time Table 6 suggests that the AQR subsample contains a great deal of heterogeneity, which is precisely what we exploit in the next subsection.

7.2 An IV approach

The second step in our exploration of the AQR aims at identifying the impact on credit supply of an exogenous variation in NPLs. The focus of the analysis therefore shifts to two measures of *changes* in credit quality: the flow of provisions over operating profits (*Provisions/Operating Profits*) and the flow of new NPLs over total outstanding loans (*NewDefault rate*). Since we are after the effect of a variation in credit quality, these flow measures are more informative than the underlying NPL ratios.

The revisions in banks' balance sheets related to the AQR exercise provide a valuable instrument for the change in credit quality recorded in 2014-15. For the 15 Italian banking groups that were subjected to the AQR we use both reclassifications from performing to non-performing portfolios and additional provisions set aside as a result of the review. These figures allow us to build our two instruments: two measures of (AQR-related) changes in provisions and in NPL ratios.[20] We use the two following specifications:

$$\begin{aligned} \Delta Loans_{ij} &= \alpha_j + \gamma\, \widehat{Provisions/Operating\ profits}_{\iota} + \beta' X_i + \varepsilon_{ij} \\ \Delta Loans_{ij} &= \alpha_j + \gamma \widehat{NewDefault\ rate}_i + \beta' X_i + \varepsilon_{ij} \end{aligned} \tag{2}$$

[20] The validity of our instruments is confirmed by the first stage of the 2SLS estimation. All three instruments (AQR provisions in basis points, AQR provisions over total assets, and AQR-related NPL ratio change) appear to be well correlated with two endogenous variables (Provisions over Operating profits and New Default rate). The F test of excluded instruments is always way higher than threshold levels for not having weak instruments (Angrist and Pischke, 2009).

The dependent variable is the log change in credit granted by bank *i* to borrower *j* between 2013 and 2014 and between 2014 and 2015. The key regressors are, alternatively, the flow of provisions over operating profits that took place in 2014-15 (*Provisions/Operating Profits*), and the flow of new NPL over total outstanding loans (*NewDefault rate*). Both indicators measure by how much credit quality deteriorated in the period under analysis in banks' balance sheets. Exploiting our loan-level dataset, we again introduce a set of firm fixed effects (α_j) that capture the overall change in credit for each borrower over the period of interest. These are effectively the static version of the firm-time fixed effects used in the regressions of Section 5. As in the previous case, they are extremely important for identification because they allow us to focus on the differences between banks that were lending to the same firm. The lagged net NPL ratio is included in the controls (*X*) in all specifications.

We analyze *Provisions/Operating Profits* first. In order to focus on its exogenous variation we instrument the regressor using alternatively two of the official outcomes of the AQR, namely (i) provisions, expressed in basis points or as share of total assets, and (ii) variations in NPL ratios associated with the reclassifications of loans to non-performing categories. The results are reported in **Table 8**. The regressions are estimated both with and without bank characteristics and include the usual set of relationship controls. The coefficient of interest is negative and significant in four specifications out of six (see columns 3 to 6). This suggests that the negative adjustments that banks had to make after the AQR did have a negative impact on lending.

In **Table 9** we replicate the analysis using the *New Default rate* as a regressor instead of the ratio of provisions to profits and instrumenting it with the variations in provisions and the variations in NPL ratios brought about by the supervisory revision. As in the previous case, the exogenous variation in default rates – as captured by the IV strategy – has a broad negative impact on credit growth in four out of six specifications.

8. Conclusions

The steep increase in non-performing bank loans (NPLs) that took place after the financial crises of 2008-2011 has brought the problem of 'legacy assets' to the center of the European policy debate. If a decline in the quality of the loans discourages bank lending, the rise in NPLs observed since 2008 might have played an important role in depriving European economies of much-needed credit, making the recovery from the crisis harder than elsewhere. The case of Italy is an interesting one to test this possibility: between 2008 and 2015 the aggregate NPL ratio of Italian banks

doubled, credit shrunk, and the country – where the structural relations between banks and firms are notoriously strong – experienced two distinct recessions.

To investigate the linkage between NPLs and the supply of bank credit, we construct a rich dataset that includes the universe of Italian banks and the evolution of their lending relations with 2.5 million borrowers over the last 8 years. The availability of loan-level information from the Italian Credit Register allows us to control thoroughly for changes in the demand for credit: in particular, we can zoom in on firms that were borrowing from more than one bank at once and check whether they systematically obtained less funds from lenders that were burdened by a higher NPL ratio. We also exploit for identification purposes the Asset Quality Review (AQR) carried out by the European Central Bank in 2014, when supervisors forced a number of adjustments to bank balance sheets which, being out of the control of the banks, can be seen as an "exogenous" source of variation in NPLs.

We find that, although exogenous shocks to NPLs can indeed cause a decline in credit supply, the correlation between NPLs and credit in our data is almost entirely driven by demand-side effects. Once these are accounted for, NPL ratios have no discernible influence on banks' lending strategies. This result points to the conclusion that, rather than causing one another, NPLs and credit were both driven by a common underlying force, namely the bad turns of the Italian business cycle. A third finding is that, even if they did not change the overall volume of bank credit, NPLs probably changed its composition, inducing banks to lend relatively less to low-profit, low-risk firms.

Improving the resilience of the banking sector remains a critical policy objective, both in Italy and elsewhere, and addressing legacy assets is certainly an important part of that process. However, our work suggests that NPLs are an easy but unlikely culprit for the weak credit flows observed in the past years, and that their role in shaping bank behavior might be easily overestimated.

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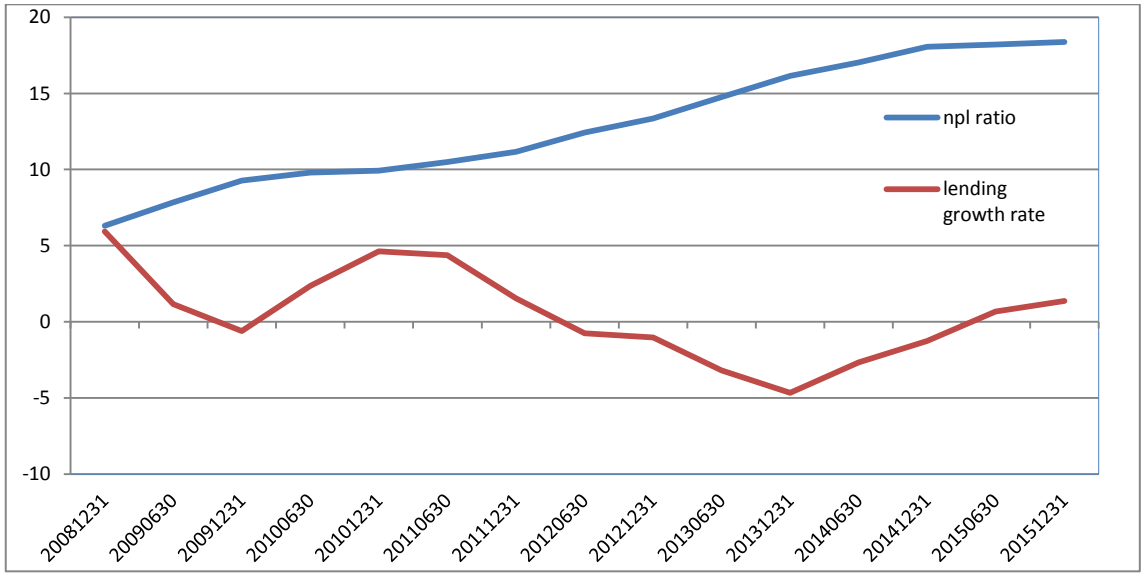
Figures and Tables

Figure 1: Aggregate NPL ratio, new NPL rate and lending growth, 2008-2015.

Panel A

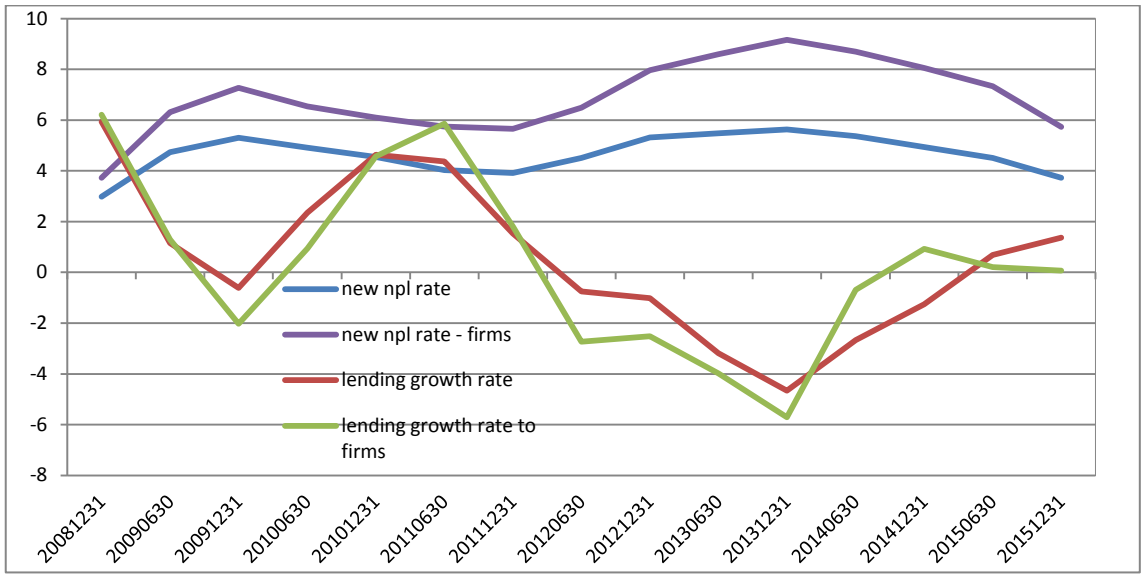
NPL ratio and lending growth



This figure shows the negative correlation between the aggregate NPL ratio and the lending growth.
The blue line plots the NPL ratio; the red line plots the lending growth ratio.

Panel B

New NPL rate and lending growth



This figure plots shows the negative correlation between the annualized flow of new NPLs over total loans (New NPL rate) and the lending growth. The blue line plots the new NPL ratio; the purple line plots the new NPL ratio to firms; the red line plots the lending growth ratio; the green line plots the lending growth rate to firms.

Figure 2: Credit growth over the period 2008-15 versus banks' initial NPL ratios.

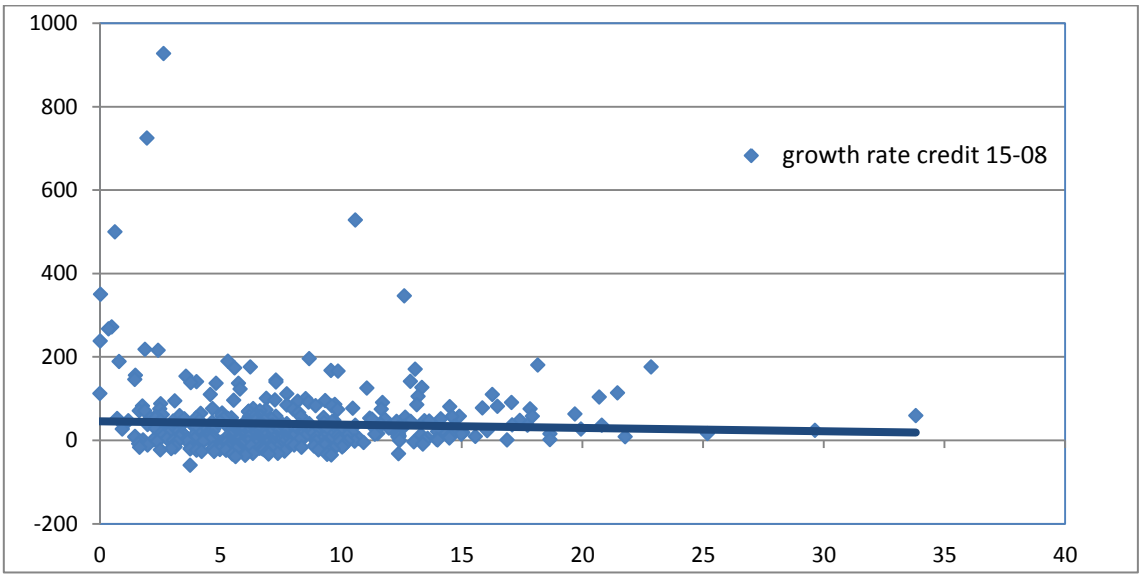


Figure 2 plots banks' credit growth rates between 2008 and 2015 (vertical axis) are plotted against their initial NPL ratios (horizontal axis). The blue line plots the trend-line.

Figure 3: Credit growth rates over the periods 2008-2010 and 2010-15 versus banks' NPL ratios at the end of 2008 and 2010.

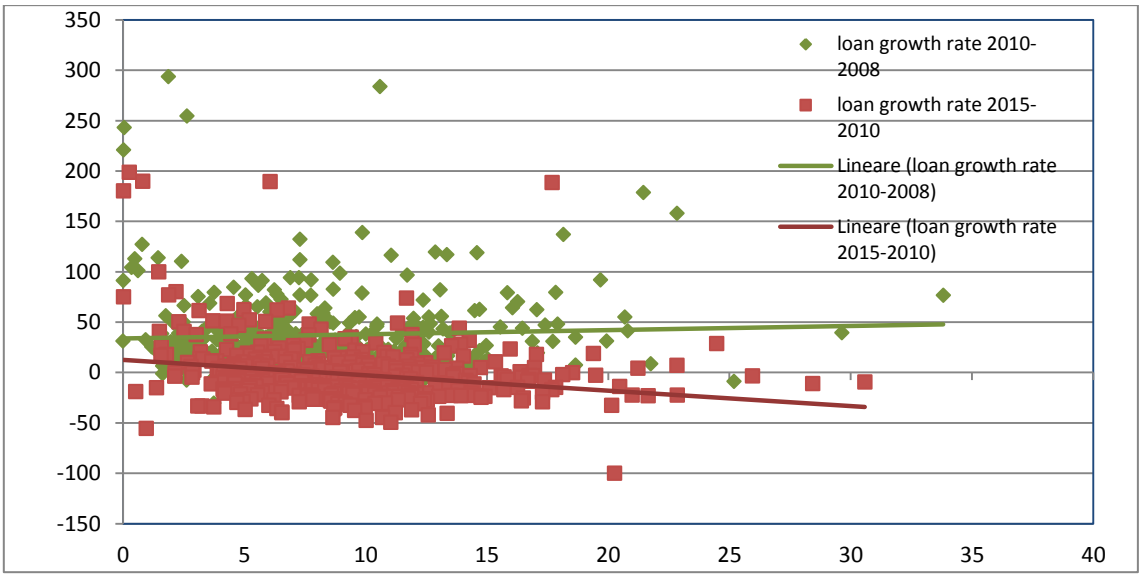


Figure 3 plots banks' credit growth rates between 2008 and 2010 - vertical axis - are plotted against their initial NPL ratios - horizontal axis (green items); banks' credit growth rates between 2010 and 2015 - vertical axis - are plotted against their initial NPL ratios - horizontal axis (red items). The green line plots the trend-line for the subsample 2008-2010; the red line plots the trend-line for the subsample 2010-2015.

Figure 4: Bank-level NPL ratios in 2008, 2010 and 2015.

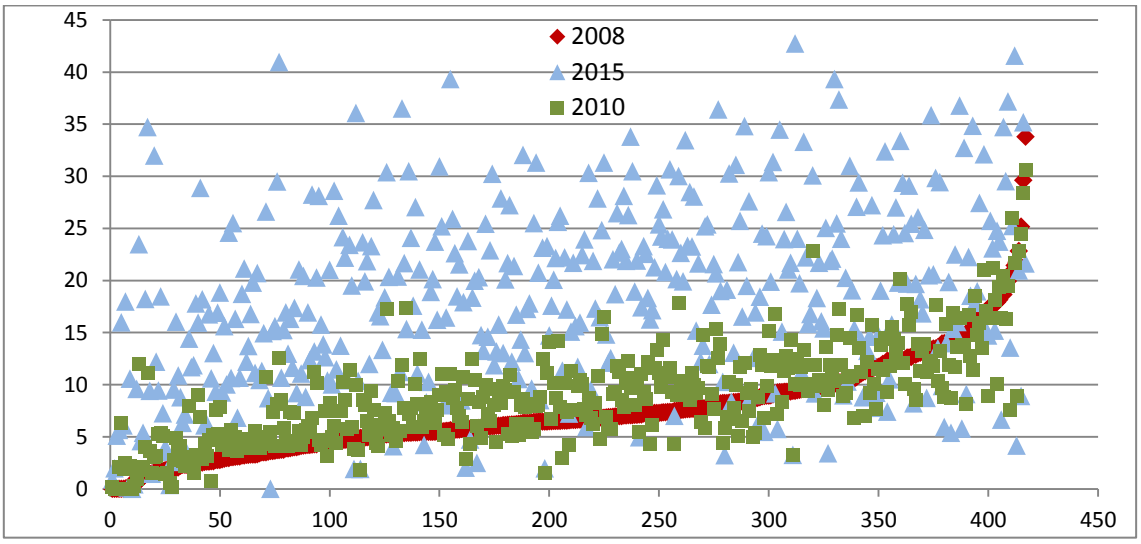


Figure 4 plots banks sorted on the horizontal axis based on their pre-Lehman NPL ratios and show how these ratios changed between 2008 and 2015. The initial ratios are displayed in red (2008); the 2010 observations are pictured in green and the 2015 in blue.

Figure 5: Correlation between NPL ratios and total assets at the end of 2008, 2010, 2015.

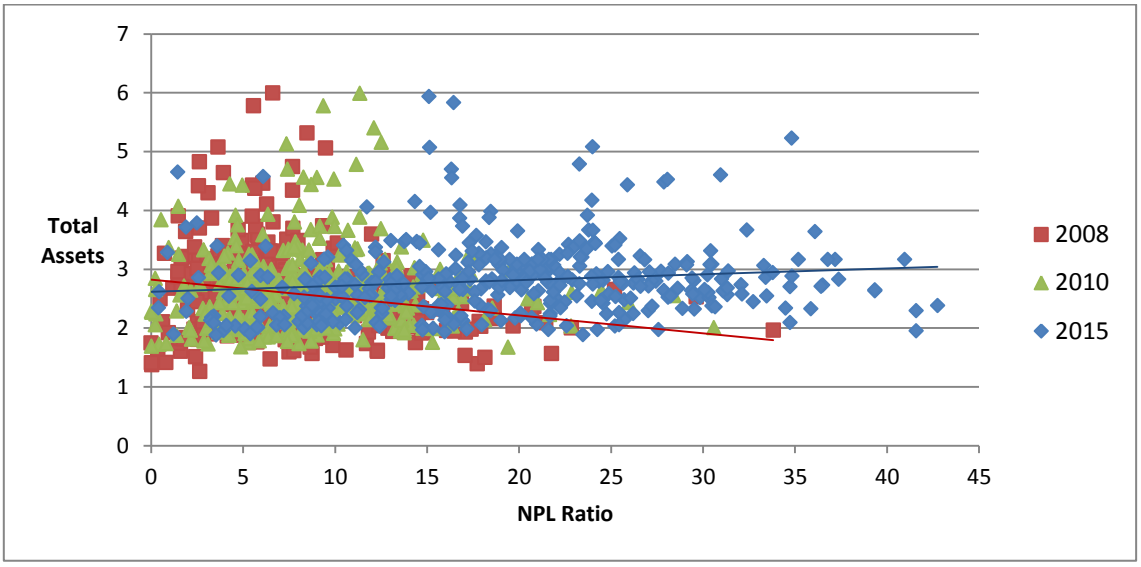


Figure 5 plots the correlation between NPL ratio (x-axis) and the log of total assets (y-axis) at the three dates of December 2008 (red items), December 2010 (green items); December 2015 (blue items). The red line plots the trend-line for the subsample 2008; the blue line plots the trend-line for the subsample 2015.

Figure 6: Correlation between NPL ratios and capital ratios at the end of 2008, 2010, 2015.

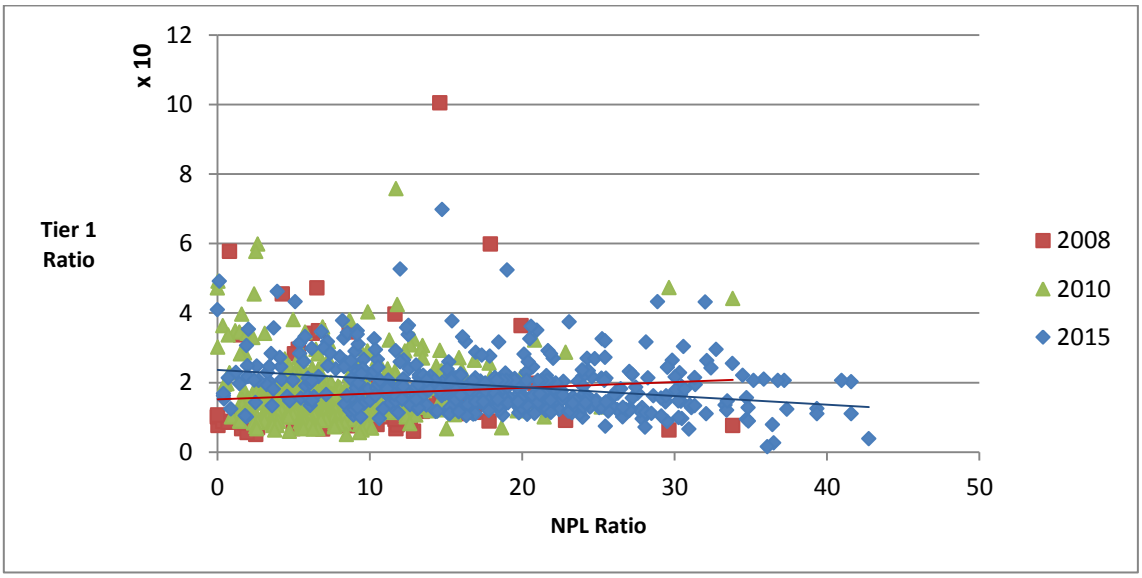


Figure 6 plots the correlation between NPL ratio (x-axis) and the tier 1 ratio (y-axis) at the three dates of December 2008 (red items), December 2010 (green items); December 2015 (blue items). The red line plots the trend-line for the subsample 2008; the blue line plots the trend-line for the subsample 2015.

Figure 7: Correlation between NPL ratios and the cost-income ratio at end 2008, 2010, 2015.

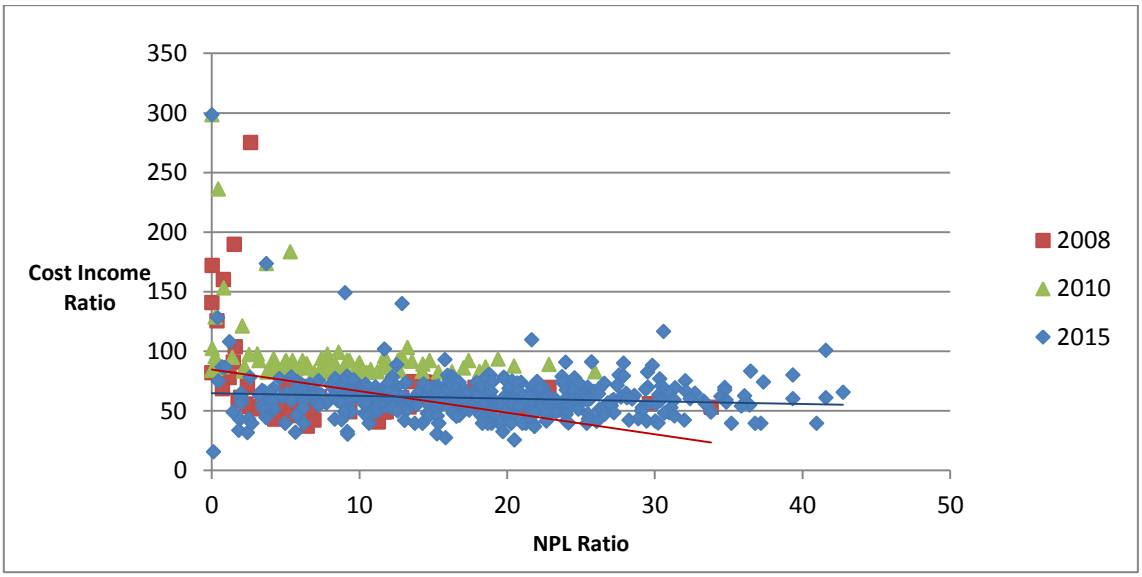


Figure 9 plots the correlation between NPL ratio (x-axis) and the cost income ratio (y-axis) at the three dates of December 2008 (red items), December 2010 (green items); December 2015 (blue items). The red line plots the trend-line for the subsample 2008; the blue line plots the trend-line for the subsample 2015.

Table 1: Basic statistics on CR data for some categories of intermediaries*

Delta of log Credit Granted

DATE	All banks	*of which: AQR Banks*	*of which: non-AQR Banks*	*of which: Mutual banks*
2008	-0.6	-1.5	1.3	3.0
2009	-3.3	-3.8	-2.3	0.9
2010	-1.4	-0.9	-2.2	-0.6
2011	-5.4	-5.8	-4.5	-2.9
2012	-7.2	-7.0	-7.6	-6.5
2013	-5.9	-6.0	-5.6	-4.0
2014	-2.1	-1.3	-3.6	-2.1
2015	-1.5	-0.9	-2.4	-1.0

*: Source: Bank of Italy, Credit Register (CR).

The panel shows the averages delta variation of credit over time.

Table 2: Bank characteristics*

All banks

[millions of euros and per cent]

DATE	*NPL ratio*	*Coverage ratio*	*Total assets*	*T1 ratio*	*Leverage ratio*	*Cost-income ratio*	*Loan loss provisions to operating profit*	*RoE*
2008	6.1	45.0	6,636	7.6	6.9	66.6	48.1	5.0
2009	9.0	39.5	6,836	8.9	7.1	61.7	60.4	4.1
2010	9.8	39.7	6,918	9.3	7.3	65.4	59.8	3.9
2011	11.0	39.8	6,964	10.1	7.5	67.6	66.6	-10.2
2012	13.2	39.3	7,138	11.1	7.1	60.9	80.4	-0.2
2013	15.9	41.7	6,725	11.1	7.1	65.7	128.8	-9.4
2014	17.7	44.5	6,706	12.3	7.1	62.0	102.1	-2.1
2015	18.1	45.4	6,696	12.7	7.2	63.7	70.3	2.7

of which

AQR banks

[millions of euros and per cent]

DATE	*NPL ratio*	*Coverage ratio*	*Total assets*	*T1 ratio*	*Leverage ratio*	*Cost-income ratio*	*Loan loss provisions to operating profit*	*RoE*
2008	6.3	46.1	158,367	6.9	6.6	66.9	50.0	5.2
2009	9.5	40.1	162,523	8.3	6.8	60.9	62.5	4.4
2010	10.1	40.4	166,710	8.8	7.0	64.7	60.5	4.3
2011	11.4	40.5	167,514	9.7	7.2	67.9	70.2	-13.9
2012	13.5	40.0	170,980	10.8	6.9	60.5	82.9	-0.9
2013	16.4	42.8	159,714	10.5	6.8	67.7	147.0	-12.8
2014	18.3	45.2	157,863	11.7	6.9	63.6	111.9	-3.6
2015	18.5	45.5	158,582	12.2	7.0	64.8	67.5	3.0

of which

non-AQR banks

[millions of euros and per cent]

DATE	*NPL ratio*	*Coverage ratio*	*Total assets*	*T1 ratio*	*Leverage ratio*	*Cost-income ratio*	*Loan loss provisions to operating profit*	*RoE*
2008	5.5	39.7	1,268	10.4	8.5	65.5	41.4	4.5
2009	7.3	36.7	1,392	10.9	8.3	64.9	50.8	3.2
2010	8.5	36.8	1,382	11.2	8.7	68.2	56.8	2.2
2011	9.7	36.8	1,440	11.5	8.6	66.5	54.4	2.5
2012	12.1	36.4	1,540	12.0	8.1	62.0	71.4	2.1
2013	14.2	37.4	1,533	12.9	7.8	59.3	82.5	0.9
2014	15.8	41.6	1,576	14.0	8.0	57.6	78.6	2.2
2015	16.8	44.9	1,576	14.5	8.2	60.3	77.7	1.7

of which

MUTUAL banks

[millions of euros and per cent]

DATE	*NPL ratio*	*Coverage ratio*	*Total assets*	*T1 ratio*	*Leverage ratio*	*Cost-income ratio*	*Loan loss provisions to operating profit*	*RoE*
2008	6.6	25.1	456	14.1	11.1	60.3	26.2	6.4
2009	8.0	24.0	495	14.5	10.9	68.3	43.3	3.8
2010	8.8	24.1	518	14.5	10.7	71.2	49.3	2.1
2011	10.3	24.8	545	14.3	10.3	68.1	55.5	2.0
2012	13.3	25.5	605	14.4	9.6	59.3	70.1	2.5
2013	16.1	30.5	638	14.7	9.1	57.4	91.3	0.5
2014	17.7	36.1	678	16.4	8.4	51.4	80.4	1.9
2015	19.1	39.8	670	16.8	8.5	56.5	88.9	-0.1

*: Source: Bank of Italy, supervisory reports.

NPL ratio is the ratio of non-performing loans to total loans. *Coverage ratio* is the ratio of loan loss provisions to non-performing loans. *Total assets* is an average value in millions of euros. *T1 ratio* is the ratio of tier 1 capital to risk-weighted assets. *Leverage ratio* is the ratio of equity to total assets. *Cost-income ratio* is the ratio of operational expenses to gross income. *Loan loss provisions to operating profit* is the ratio of loan loss provisions to income net of operating expenses. *RoE* is the ratio of net profit to equity.

Table 3: Net NPL ratio

VARIABLES	(1) No fixed effects	(2) Firm fixed effects	(3) Firm*time Fixed effects	(4) Firm*time FE Relationship ctrls	(5) Firm*time FE Relationship ctrls Bank fixed effects
Net NPL ratio	0.0577	-0.303***	0.0122	-0.0698	-0.122
	(0.0668)	(0.0725)	(0.0746)	(0.0757)	(0.115)
Drawn over granted				-0.0156***	-0.0109***
				(0.00383)	(0.00321)
Share of Overdraft				0.0969***	0.0896***
				(0.00349)	(0.00242)
Share of Total Granted				-0.311***	-0.325***
				(0.0131)	(0.0120)
Constant	-4.073***				
	(0.503)				
Observations	4540356	4534730	4473528	4473528	4473528
R-squared	0.000	0.091	0.353	0.375	0.378

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Net NPL ratio and balance sheet variables

VARIABLES	(1) No fixed effects	(2) Firm fixed effects	(3) Firm*time	(4) Firm*time FE Relationship ctrls	(5) Firm*time FE Relationship ctrls Bank fixed effects
Net NPL ratio	0.0197	-0.225**	-0.0534	-0.0806	-0.0865
	(0.108)	(0.113)	(0.0744)	(0.0665)	(0.0942)
Bank size	0.142	0.105	0.181**	0.488***	-1.665
	(0.108)	(0.0981)	(0.0842)	(0.115)	(1.459)
Tier 1 ratio	0.193***	-0.0783	0.166***	0.247***	0.386***
	(0.0474)	(0.0738)	(0.0555)	(0.0661)	(0.0827)
Return on Equity	0.0816***	0.0978***	-0.00410	-0.00142	-0.000463
	(0.0249)	(0.0302)	(0.0243)	(0.0247)	(0.0266)
Writedowns/offs over operprofits (lag)	1.025***	1.041***	0.237	0.100	0.231
	(0.364)	(0.395)	(0.224)	(0.255)	(0.293)
Share of wholesale funding	3.142***	2.666*	-1.230	-1.257	-1.916
	(1.218)	(1.366)	(1.051)	(1.028)	(1.472)
Mutual	1.775***	3.173***	1.323**	2.026***	
	(0.648)	(0.717)	(0.516)	(0.472)	
Drawn over granted				-0.0149***	-0.0108***
				(0.00335)	(0.00282)
Share of Overdraft				0.0954***	0.0909***
				(0.00355)	(0.00276)
Share of Total Granted				-0.308***	-0.317***
				(0.0133)	(0.0124)
Constant	-7.328***				
	(1.127)				
Observations	3805046	3799702	3749715	3749715	3749715
R-squared	0.001	0.100	0.353	0.375	0.377

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: New bad loan rate

VARIABLES	(1) No fixed effects	(2) Firm fixed effects	(3) Firm*time Fixed effects	(4) Firm*time FE Relationship ctrls	(5) Firm*time FE Relationship ctrls Bank fixed effects
New Bad Loan Rate	0.245	-0.586***	-0.122	-0.394**	-0.300
	(0.181)	(0.186)	(0.157)	(0.187)	(0.185)
Drawn over granted				-0.0162***	-0.0109***
				(0.00394)	(0.00324)
Share of Overdraft				0.0970***	0.0897***
				(0.00346)	(0.00243)
Share of Total Granted				-0.311***	-0.325***
				(0.0129)	(0.0119)
Constant	-4.301***				
	(0.497)				
Observations	4536080	4530260	4467076	4467076	4467076
R-squared	0.000	0.091	0.353	0.375	0.378

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Firm characteristics

VARIABLES	(1) **SMALL** Size below median	(2) **LARGE** Above median	(3) **LOW PROFITS** Roa below median	(4) **HIGH PROFITS** Roa below median	(5) **LOW LEVERAGE** Leverage below median	(6) **HIGH LEVERAGE** Leverage above median	(7) **LOW RISK** Z-score above 3	(8) **HIGH RISK** Z-score below 4
Net NPL ratio	-0.0495	-0.0319	-0.126*	0.101	0.0272	-0.162*	-0.317**	-0.00418
	(0.0763)	(0.0557)	(0.0734)	(0.0951)	(0.0769)	(0.0882)	(0.139)	(0.0713)
Bank size	0.397**	0.392***	0.501***	0.217*	0.240***	0.695***	0.720***	0.355***
	(0.154)	(0.0863)	(0.108)	(0.117)	(0.0837)	(0.179)	(0.249)	(0.0926)
Tier 1 ratio	0.280***	0.217***	0.280***	0.231***	0.266***	0.243***	0.226**	0.264***
	(0.0800)	(0.0343)	(0.0595)	(0.0798)	(0.0581)	(0.0829)	(0.0931)	(0.0630)
Return on Equity	-0.0165	-0.0219	-0.0188	-0.0168	-0.0179	-0.0171	-0.00739	-0.0200
	(0.0267)	(0.0154)	(0.0223)	(0.0244)	(0.0212)	(0.0259)	(0.0328)	(0.0220)
Writedowns/offs over operprofits (lag)	-0.222	-0.0187	-0.142	-0.190	-0.197	-0.105	0.119	-0.209
	(0.321)	(0.151)	(0.220)	(0.321)	(0.246)	(0.277)	(0.276)	(0.258)
Share of wholesale funding	-0.714	0.266	-0.268	-0.687	-0.142	-1.044	-0.744	-0.443
	(1.086)	(0.886)	(0.998)	(1.196)	(1.042)	(1.066)	(1.180)	(1.023)
Mutual	2.072***	2.668***	2.229***	2.326***	2.145***	2.217***	1.504	2.308***
	(0.592)	(0.310)	(0.466)	(0.517)	(0.376)	(0.729)	(0.990)	(0.418)
	(0.0145)	(0.00971)	(0.0123)	(0.0146)	(0.0118)	(0.0149)	(0.0140)	(0.0130)
Observations	3003764	1468800	2818089	1654475	2818814	1653750	597038	3875526
R-squared	0.351	0.454	0.379	0.369	0.382	0.367	0.382	0.375

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: AQR and non-AQR banks

VARIABLES	(1)	(2)	(3)	(4)
AQR bank	5.343***		12.12***	
	(1.543)		(4.032)	
AQR bank * post AQR	8.702***	8.911***	4.110	0.905
	(2.738)	(2.785)	(5.796)	(6.848)
NPL ratio			0.151	0.779**
			(0.205)	(0.379)
Npl ratio * post AQR			-0.115	-0.253
			(0.161)	(0.197)
Npl ratio * AQR bank			-0.977**	-3.109**
			(0.493)	(1.513)
Npl ratio * AQR bank * post AQR			0.713	1.679*
			(0.651)	(0.943)
Relationship level controls	yes	yes	yes	yes
Firm*Time fixed effects	yes	yes	yes	yes
Bank fixed effects	no	yes	no	yes
Observations	633978	633968	595319	595316
R-squared	0.423	0.429	0.429	0.433

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: AQR variables used as instruments for provisions

	Provisions over operating profits instrumented by					
VARIABLES	(1) AQR-provisions (basis points)	(2) AQR-provisions (basis points)	(3) AQR-provisions (over total assets)	(4) AQR-provisions (over total assets)	(5) AQR-delta NPL	(6) AQR-delta NPL
Provisions over operating profits	-3.993	-178.3	-5.572***	-11.28*	-7.710***	-10.37***
	(2.881)	(2142)	(1.619)	(5.457)	(1.218)	(2.065)
Bank size		-78.16		-2.939		-0.641
		(957.7)		(2.381)		(1.417)
Tier 1 ratio		6.113		1.481***		0.714
		(59.34)		(0.301)		(0.583)
Return on Equity		-6.329		-0.357*		-0.307***
		(76.56)		(0.199)		(0.0910)
Net NPL ratio		5.130		0.531**		0.212
		(61.97)		(0.192)		(0.185)
Bank balance sheet variables	no	yes	no	yes	no	yes
Firm time fixed effects	yes	yes	yes	yes	yes	yes
Relationship level controls	yes	yes	yes	yes	yes	yes
Observations	157001	157001	157001	157001	157001	157001
R-squared	0.462	-0.632	0.462	0.462	0.462	0.463

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: AQR variables used as instruments for new default rate

	New default rate instrumented by					
VARIABLES	(1) AQR-provisions (basis points)	(2) AQR-provisions (basis points)	(3) AQR-provisions (over total assets)	(4) AQR-provisions (over total assets)	(5) AQR-delta NPL	(6) AQR-delta NPL
New default rate	-0.827	-1.917	-1.233***	-1.596***	-1.713***	-2.330***
	(0.588)	(1.369)	(0.367)	(0.510)	(0.338)	(0.358)
Bank size		2.625***		2.544***		2.730***
		(0.632)		(0.478)		(0.549)
Tier 1 ratio		-0.591		-0.296		-0.970
		(1.309)		(0.598)		(0.554)
Return on Equity		0.171*		0.150***		0.198***
		(0.0942)		(0.0425)		(0.0436)
Net NPL ratio		0.652		0.580**		0.745***
		(0.373)		(0.204)		(0.171)
Bank balance sheet variables	no	yes	no	yes	no	yes
Firm time fixed effects	yes	yes	yes	yes	yes	yes
Relationship level controls	yes	yes	yes	yes	yes	yes
Observations	157001	157001	157001	157001	157001	157001
R-squared	0.461	0.463	0.462	0.463	0.462	0.462

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix

Panel 1*

Average Share of Total Credit from each Bank

DATE	All banks	*of which: AQR Banks*	*of which: non-AQR Banks*	*of which: Mutual banks*
2008	31.4	31.8	30.5	34.2
2009	34.9	35.0	34.7	38.9
2010	35.1	35.2	34.9	39.0
2011	34.8	34.8	34.9	39.1
2012	34.7	34.7	34.5	38.9
2013	34.6	34.7	34.6	39.1
2014	34.7	34.9	34.2	38.9
2015	34.6	35.0	33.9	38.8

Panel 2*

Drawn Credit over Granted Credit

DATE	All banks	*of which: AQR Banks*	*of which: non-AQR Banks*	*of which: Mutual banks*
2008	71.8	76.4	62.6	60.8
2009	67.8	70.0	63.8	61.8
2010	68.3	69.9	65.3	63.6
2011	68.8	69.5	67.5	66.1
2012	72.8	75.3	68.3	67.3
2013	69.6	70.9	67.5	66.4
2014	90.1	103.6	66.3	65.4
2015	69.4	71.7	65.3	64.2

Panel 3*

Share of Overdraft over Granted Credit

DATE	All banks	*of which: AQR Banks*	*of which: non-AQR Banks*	*of which: Mutual banks*
2008	26.4	25.7	27.8	32.2
2009	26.5	26.0	27.4	30.6
2010	25.3	24.7	26.5	29.4
2011	25.5	25.1	26.4	28.4
2012	26.2	25.8	26.8	28.8
2013	25.9	25.7	26.2	28.1
2014	24.5	24.2	25.2	26.8
2015	23.2	22.8	23.8	25.2

*: Source: Bank of Italy, Credit Register (CR).

Panels 1-3 show the average values of three very relevant features of bank-firm relationship, the share of the total credit that a firm obtained from a given bank (Panel 1); the ratio of drawn credit over committed credit (Panel 2); the share of overdraft debt that a given borrower has towards each lender (Panel 3).